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Comparison of postoperative clinical effects of erector spinae plane block and patient controlled analgesia in thoracotomy patients

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Abstract

Aim: The aim of this study was to compare Erector Spinae Plane (ESP) block and Patient Controlled Analgesia (PCA) methods for postoperative analgesia in patients undergoing thoracotomy surgery in terms of clinical efficacy and complication.

Material and Methods: The study included 80 patients who had thoracotomy surgery, 40 of whom had ESP block (Group E) and 40 of whom had PCA (Group P). Demographic data were recorded. In Group E patients, ESP block was administered with 20 ml of 0.5% bupivacaine accompanied by ultrasound, patients in Group were administered 10 µg/ml of fentanyl with 2 ml/h baseline and 2 ml bolus doses with a 15-minute lock-up period. The VAS (Visual Analog Scale) and NRS (Numerical Rating Scale) scores of the groups, time of the first additional analgesia, total amount of additional analgesic consumed, and side effects (nausea-vomiting, pruritus) were recorded.

Results: VAS and NRS scores were significantly lower in Group E ($p<0.05$). The duration of initial analgesia demand in Group E was longer, and the total opioid consumption was significantly lower in Group E ($p<0.05$). The incidence of nausea, vomiting and pruritus was significantly lower in Group E than in Group P ($p<0.05$).

Discussion: The ESP block is an effective analgesic technique in patients undergoing thoracotomy surgery, providing lower VAS and NRS values and lower opioid consumption with minor side effects in comparison to PCA.

Keywords

Erector Spinae Block, Patient Controlled Analgesia, Postoperative Analgesia, Thoracotomy

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Introduction

A thoracotomy involves one of the most painful surgical incisions, and the resulting pain is one of the leading causes of decreased respiratory function. Decreasing this pain is of vital importance for the prevention of atelectasis and the facilitation of cough, and also for patient comfort [1].

The erector spinae plane block (ESP) technique was first defined by Forero et al. for blocking thoracic neuropathic pain, and since then there have been few studies on its use for postoperative analgesia in different surgical procedures [2,3]. In this technique, a local anesthetic (LA) is injected under the erector spinae muscle, and the LA is expected to be distributed cranially to three vertebral levels and caudally to four levels [4]. Another method of pain control is patient-controlled analgesia (PCA), which was first described by Sechzer in 1968 as an intravenous opioid application. A system in which the patient controls the dose of the analgesic drug was developed after the use of low doses of intravenous (IV) opioid applications was demonstrated to be superior to conventional methods [5].

The present study makes a comparison of the postoperative analgesic PCA and ESP block techniques in terms of clinical efficacy and complications in patients undergoing thoracotomy surgery.

Material and Methods

The present retrospective study was conducted in accordance with the principles of the Declaration of Helsinki and was launched following approval by the Local Ethics Committee (2019/447). After informed consent was obtained, the medical records of patients who had undergone routine PCA or US-guided ESP were accessed, and those aged 18–70 years and with an ASA score of I, II or III who underwent ESP block or PCA application as a postoperative analgesic technique following thoracotomy surgery, between March 1 and November 1, 2019 were included in the study. Patients with missing medical data were excluded from the study.

The patients were divided into two groups as Group E (ESP block) and Group P (PCA), with 40 patients in each group. Patients in Group E were placed in a lateral position following thoracotomy surgery, and the nerve block was applied before emergence from anesthesia. Sterile gloves were used and the puncture site was sterilized using 10% povidone iodine (Isosol®), in accordance with asepsis-antisepsis rules, and a sterile drape was applied. The ESP block was performed under USG guidance (GE Logiq E brand USG and Linear IO 4–12 MHz probe) with a 2–4 cm adjustable depth, at a frequency of 10–12 MHz. The probe was placed approximately 3 cm lateral to the T5 spinous process on the parasagittal plane, and an 85-mm block needle (Echoplex, 21G nerve block needle) was introduced through the skin using the in-plane approach. The trapezius, rhomboid and erector spinae muscles were passed through, and when the needle touched the transverse process (approximately 2.5–3 cm depth), a test dose of 1 ml of 0.9% NaCl was administered between the fascia of the erector spinae muscle and the transverse process of the vertebra, and the location of the needle and the cranio-caudal distribution were confirmed. The ESP block was subsequently applied with the administration of 20 ml of 0.5% bupivacaine into the erector spinae region. For Group P, 10 µg/ml fentanyl in a 100 ml isotonic NaCl solution was prepared 45 minutes before the end of the operation, and was administered through a PCA device (CADD-Legacy® 6300 ambulatory infusion pump) at a 2.0 ml/h basic rate, with 15 minutes of lockout duration and 2.0 ml bolus doses.

All patients received 100 mg tramadol IV as a standard dose at the end of the operation, prior to awakening from the anesthesia. Then patients were transferred to the intensive care unit (ICU) for close monitorization. The VAS (visual analog scale) was applied to all patients (in which the patient was asked to indicate the appropriate level of pain [in mm] on a 100 mm scale of 0–100, in which 0 = no pain, and 100 = most severe pain) [6] and the NRS (numerical rating scale) (in which the patient reports the severity of pain on a scale in which 0 equates to no pain and 10 equates to the most severe pain) at postoperative hours 0, 1, 6, 12 and 24 [7]. Furthermore, the time of administration of the first analgesic and the requirement for additional analgesics, the total analgesic IV dosage over 24 hours, and the presence of nausea, vomiting, itching or shoulder pain were all recorded. Tramadol 100 mg IV was administered as an additional analgesic to patients with a VAS of 40–50 mm, and morphine 3 mg subcutaneously to patients with a VAS of >50 mm. Metoclopramide 10 mg IV was given to patients who developed nausea and vomiting.

Statistical Analysis

The minimum number of patients in each group required to achieve a difference of 1±1.48 units was determined as 36 as significant (α=0.05, 1-β=0.80). G power version 3.1 was used for the analysis of data. The Shapiro-Wilk test was used to evaluate the normal distribution of numerical variables; we have shown the numerical (quantitative) data by descriptive statistics as mean±SD and median (Q1-Q3) depending upon normality and nominal data as n (%). A two-group comparison of the normally distributed data was made using the Student's t-test, while non-normally distributed were numerical variables using Mann-Whitney U test. Associations between categorical variables were tested with a Chi-square test. IBM SPSS Statistics for Windows (Version 22.0. Armonk, NY: IBM Corp.) was used for the analyses. P<0.05 was accepted as significant.

Results

A total of 80 patients were included in the study, with 40 patients assigned to each group. Of the total, 26.2% (n=21) were females and 73.8% (n=59) were males; the mean age was 50.90±15.28 years with an age range of 18–70 years; and the mean BMI was 24.36±5.39. No statistically significant differences were noted in the descriptive variables of the two groups (p>0.05) (Table 1).

Comparison of the MAP (Mean Arterial Pressure) in the two groups revealed statistically significantly lower values in Group E than in Group P at four measurement times other than at hour 0 (p<0.05).

Comparison of the VAS scores in groups E and P revealed p-values of 0.001 at hour 0, 0.005 at hour 1, <0.001 at hour 6, 0.004 at hour 12 and 0.003 at hour 24. Comparison of the NRS scores in Groups E and P revealed p-values of 0.003 at hour 0, 0.008 at hour 1 and 0.002 at hour 6. The VAS and NRS values were found to be statistically significantly lower in Group E than

in Group P at 0, 1 and 6 hours, and VAS values were found to be statistically significantly lower in Group E than in Group P at 12 and 24 hours (Table 2).

The difference between the two groups in the start time of morphine administration was statistically insignificant (p=0.072). The time of the first tramadol dose following the 100 mg standard tramadol administration was found to be later in Group E than in Group P, although not statistically significant (p=0.594).

The amount of morphine administered at postoperative hours 0, 1, 6, 12 and 24 was found to be statistically significantly lower in Group E than in Group P (Postoperative hour 0 [p=0.003], hour 1 [p=0.001], hour 6 [p<0.001], hour 12 [p=0.005] and hour 24 [p=0.002]). The total amount of tramadol consumed at hours 12 (p=0.043) and 24 (p=0.018) was found to be statistically significantly lower in Group E than in Group P (Table 3).

The number of patients with nausea and vomiting in the two groups was compared, and it was present in 20% (n=8) and 47.5% (n=19) of the patients in Groups E and P, respectively (p=0.009). Pruritus was observed in 15% (n=6) and 40% (n=16) of the patients in the E and P Groups, respectively (p=0.012).

Table 1. Descriptive data of groups

	Group E	Group P	P value
Gender (F/M)	9(22.5%) / 31(77.5)	12(30%) / 28(70%)	0.446
Age (years)	51.7 ± 15.4	50.1 ± 15.3	0.632
Height (cm)	171.9 ± 7.4	171.7 ± 8.0	0.942
Weight (kg)	73.5 ± 13.8	71.6 ± 15.6	0.555
BMI	24.7 ± 5.1	24.1 ± 5.8	0.636
ASA I/II/III n (%)	2(5%) / 10(25%) / 28(70%)	2(5%) / 13(32.5%) / 25(62.5%)	0.755
Duration of surgery (minutes)	207.9 ± 73.4	213 ± 59.7	0.723

F/M: Female/Male n(%), BMI: Body Mass Index, ASA: American Society of Anesthesiologists n(%), Mean± SD, p<0.05 statistically significant

Table 2. Comparison of the VAS and NRS scores of the groups

VAS Value (Mean)	Group E	Group P	p value
0. hour	40.0 (28.0-7.0)	52.5 (43.0-64.8)	0.001
1. hour	30.0 (24.0-7.0)	36.5 (31.0-42.0)	0.005
6. hour	28.0 (21.0-3.5)	36.0 (27.3-46.8)	<0.001
12. hour	27.0 (22.0-7.0)	34.0 (28.0-43.8)	0.004
24. hour	28.0 (21.3-1.0)	32.0 (24.0-42.5)	0.003
NRS Value (Mean)			
0. hour	4.0 (3.0-4.0)	5.0 (4.0-5.8)	0.003
1. hour	3.0 (2.0-3.0)	3.0 (3.0-4.0)	0.008
6. hour	2.0 (2.0-3.0)	3.0 (2.3-4.0)	0.002
12. hour	3.0 (2.0-3.0)	3.0 (3.0-4.0)	0.050
24. hour	3.0 (2.0-3.0)	3.0 (2.0-4.0)	0.221

Median (Q1-Q3), p<0.5 statistically significant

Table 3. Comparison of morphine and tramadol consumption between groups

Morphine Consumption (mg)	Group E	Group P	p value
0. hours	0.0 (0.0-0.0)	3.0 (0.0-3.0)	0.003
1. hours	0.0 (0.0-1.5)	3.0 (0.0-3.0)	0.001
6. hours	0.0 (0.0-3.0)	3.0 (0.0-3.0)	<0.001
12. hours	0.0 (0.0-3.0)	3.0 (0.0-3.0)	0.005
24. hours	0.0 (0.0-3.0)	3.0 (0.0-5.3)	0.002
Tramadol Consumption (mg)			
6. hours	100.0 (100.0-100.0)	100.0 (100.0-100.0)	0.242
12. hours	100.0 (100.0-100.0)	100.0 (100.0-200.0)	0.043
24. hours	100.0 (100.0-200.0)	200.0 (100.0-200.0)	0.018

Median (Q1-Q3), p<0.05 statistically significant

Discussion

In this retrospective clinical study, we compared ESP block and PCA through an analysis of 80 patients undergoing thoracotomy surgery. It was found that the postoperative pain scores in patients who were applied the ESP block technique were statistically significantly lower than in those who were applied the PCA technique. Furthermore, additional analgesics were started later in the ESP block group, lower doses of additional analgesics were required, and incidences of nausea-vomiting and itching were lesser in this group of patients. In addition, when vital signs were evaluated, MAP values were within physiological ranges and were statistically significantly lower in patients with ESP block.

Various approaches to analgesia have been suggested for the management of acute post-thoracotomy pain, among which PCA is a common approach that has long been used for the resolution of pain, and allows the patient to self- administer the analgesic. Both non-opioid and opioid agents may be used in PCA applications. As a new interfascial approach, ESP block has recently been identified as a simple and safe alternative analgesic technique for post-surgical thoracic pain [8-10].

Tulgar et al. [11] reported ESP block to be an efficient and safe interfascial plane block when used as a part of a multimodal analgesia plan. Given the ease of the US-guided ESP block technique, the distance maintained from the pleura, neuroaxial and vascular structures, and the subsequent lower rate of complications, ESP block can be recommended for postoperative analgesia in patients who have undergone thoracic surgery. Its distribution to a large dermatomal area without the need for multiple injections is another advantage of this technique.

Ciftci et al. [12] in their study evaluating the efficacy of ESP block after VATS applied an ESP block of 20 ml of 0.25% bupivacaine, while the control group received no such application. Comparison of the VAS scores revealed similar results to those recorded in the present study, with statistically significantly lower values identified in the ESP group than in the control group. He et al. [13] applied a block using 0.5% ropivacaine 20 ml in the ESP group, while no such application was made in the control group. Subsequently, the pain experienced by the patients, evaluated with a VAS, was statistically significantly lower in the ESP group than in the control group, which concurs with the findings of the present study.

Gurkan et al. [4] in their study evaluating the effect of ESP block on postoperative opioid consumption after breast surgery applied a block at the T4 level using 20 ml 0.25% bupivacaine in an ESP Group. NRS scores were found to be lower in the ESP block group than in the control group. In a study by Sharma et al. [14], ESP block was applied in the ESP group at level T5 using 0.5% ropivacaine in a dose of 0.4 ml/kg following a total mastectomy, while the control group did not undergo any

intervention. Similar to the present study, patient-reported NRS values were statistically significantly lower in the group with ESP block than in the control group.

In a study by Yayik et al. [15], evaluating the efficacy of ESP block for postoperative analgesia in patients who had undergone lumbar spinal decompression surgery, ESP block of 20 ml 0.25% bupivacaine was applied to one group, while the other group received no intervention. The authors recorded a statistically significantly shorter time until the first request for additional analgesia in the ESP block group than in the control group, similar to the present study. Abu Elyazed et al. [16] applied a bilateral ESP block of 0.25% bupivacaine in a dose of 20 ml at level T7 in their study evaluating the effects of ESP block in patients who underwent open epigastric hernia repair. The mean duration until the first request for additional analgesia was 455 minutes and 30 minutes in the patients who underwent ESP block and the control group, respectively.

Yao et al. [17], in their study evaluating the effect of ESP block after VATS on the quality of postoperative healing, applied an ESP block to half of the patients in the form of 20 ml of 0.5% ropivacaine, and normal saline at the same level to the remaining patients as controls. Total opioid consumed was reported to be statistically significantly lower in the ESP group than in the control group in the first 24 hours. In a study by Seelam et al. [18] evaluating the efficacy of ESP block in post-mastectomy patents, the block applied in the ESP group was 30 ml 0.25% bupivacaine at level T3, while the control group received no block. The total postoperative morphine consumption in the study was similar to that reported in the present study, being statistically significantly lower in patients with ESP block.

The major side effects recorded in the present study were nausea-vomiting and itching, which were observed to be statistically significantly lower in the group with ESP block. The reason for the higher incidences of both side effects observed in the group with PCA in the present study was attributed to the greater amounts of opioids consumed [19,20]. In a study by Yao et al. [17] in which an ESP block was administered to the experimental group after VATS, the incidence of nausea-vomiting was found to be higher in the control group than in the ESP group.

Further extensive multicenter studies are needed to better understand the effects, indications and contraindications of this block.

Conclusion

ESP block was found to lengthen the duration of the requirement for first postoperative analgesic administration, to decrease the additional and total analgesic requirement, and to decrease the side effects associated with opioid analgesic use in patients who have undergone thoracotomy. We thus suggest ESP block as a good alternative to pain control following thoracotomy.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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